

ADVANCED MACHINING TOWARDS IMPROVED MACHINABILITY OF DIFFICULT-TO-CUT MATERIALS

Edited by:
A.K.M. Nurul Amin (Chief Editor)
Dr. Erry Yulian Triblas Adesta
Dr. Mohammad Yeakub Ali



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SECTION A: HEAT ASSISTED MACHINING	1
1. CHAPTER 1: INFLUENCE OF WORKPIECE PREHEATING ON CHATTER AND MACHINABILITY OF TITANIUM LOY - TI6AL4V	1
2. CHAPTER 2: MACHINABILITY IMPROVEMENT IN END OF MILLING TITANIUM ALLOY TI-6AL-4V THROUGH PREHEATING	9
3. CHAPTER 3: SOME ASPECTS OF IMPROVED MACHINABILITY IN PREHEATED MACHINING OF TITANIUM ALLOY TI-6AL-4V	19
4. CHAPTER 4: MACHINABILITY ASPECTS IN HEAT ASSISTED MACHINING OF HARDENED STEEL AISI H13 USING COATED CARBIDE TOOL	27
5 CHAPTER 5: TOOL WEAR AND SURFACE ROUGHNESS ASPECTS IN HEAT ASSISTED END MILLING OF AISI D2 HARDENED STEEL	35
6 CHAPTER 6: MODELING IN PREHEATED MACHINING OF AISI D2 HARDENED STEEL	43
7 CHAPTER 7: RELATIVE PERFORMANCES OF PREHEATING, CRYOGENIC COOLING AND HYBRID TURNING OF STAINLESS STEEL AISI 304	49
SECTION B: CHATTER AND SELECTED METHODS OF CHATTER SUPPRESSION	57
8 CHAPTER 8: ROLE OF THE FREQUENCY OF SECONDARY SERRATED TEETH IN CHATTER FORMATION DURING TURNING OF CARBON STEEL AISI 1040 AND STAINLESS STEEL	57
9 CHAPTER 9: INFLUENCE OF THE ELASTIC SYSTEM AND CUTTING PARAMETERS ON CHATTER DURING MACHINING OF MILD STEEL	65
10 CHAPTER 10: INFLUENCE OF CHATTER ON TOOL LIFE DURING END MILLING OF ALUMINIUM AND ALUMINIUM ALLOY ON VMC	75

11	CHAPTER 11: A NEW METHOD FOR CHATTER SUPPRESSION AND IMPROVEMENT OF SURFACE ROUGHNESS IN END MILLING OF MILD STEEL	83
12	CHAPTER 12: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF MEDIUM CARBON STEEL	91
13	CHAPTER 13: APPLICATION OF PERMANENT ELECTROMAGNET FOR CHATTER CONTROL IN END MILLING OF TITANIUM ALLOY - Ti6Al4V	99
14	CHAPTER 14: CHATTER SUPPRESSION IN END MILLING OF TITANIUM ALLOY Ti6Al4V APPLYING PERMANENT MAGNET CLAMPED ADJACENT TO THE WORKPIECE	107
	SECTION C: MODELING AND OPTIMIZATION IN MACHINING	117
15	CHAPTER 15: A COUPLED ARTIFICIAL NEURAL NETWORK AND RSM MODEL FOR THE PREDICTION OF CHIP SERRATION FREQUENCY IN END MILLING OF INCONEL 718	117
16	CHAPTER 16: APPLICATION OF RESPONSE SURFACE METHODOLOGY COUPLED WITH GENETIC ALGORITHM FOR SURFACE ROUGHNESS OF INCONEL 718	123
17	CHAPTER 17: DEVELOPMENT OF A MATHEMATICAL MODEL FOR THE PREDICTION OF SURFACE ROUGHNESS IN END MILLING OF STAINLESS STEEL SS 304	133
18	CHAPTER 18: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE CUTTING FORCE IN END MILLING OF INCONEL 718 ALLOY	143
19	CHAPTER 19: DEVELOPMENT OF AN ARTIFICIAL NEURAL NETWORK ALGORITHM FOR PREDICTING THE SURFACE	149
20	CHAPTER 20: DEVELOPMENT OF TOOL LIFE PREDICTION MODEL OF TiAlN COATED TOOLS DURING PART C: HIGH SPEED HARD MILLING OF AISI H13 STEEL	155
21	CHAPTER 21: MODELING FOR SURFACE ROUGHNESS IN END-MILLING OF TITANIUM ALLOY Ti-6Al-4V USING UNCOATED WC INSERTS	161

22	CHAPTER 22: MODELING OF SURFACE ROUGHNESS DURING END MILLING OF AISI H13 HARDENED TOOL STEEL	167
23	CHAPTER 23: MODELING OF TOOL LIFE USING RESPONSE SURFACE METHODOLOGY IN HARD MILLING OF AISI D2 TOOL STEEL	175
24	CHAPTER 24: OPTIMIZATION OF SURFACE ROUGHNESS IN HIGH SPEED END MILLING OF TITANIUM ALLOY Ti-6Al-4V UNDER DRY CONDITION	181
25	CHAPTER 25: COMPARISON OF SURFACE ROUGHNESS IN END-MILLING OF TITANIUM ALLOY Ti-6Al-4V USING UNCOATED WC-CO AND PCD INSERTS THROUGH GENERATION OF MODELS	189
26	CHAPTER 26: ASSESSMENT OF PERFORMANCE OF UNCOATED AND COATED CARBIDE INSERTS IN END MILLING OF Ti-6Al-4V THROUGH MODELLING	195
	SECTION D: CRYOGENIC AND HIGH SPEED MACHINING OF METALS AND NON METALS	203
27	CHAPTER 27: THE EFFECT OF CRYOGENIC COOLING ON MACHINABILITY OF STAINLESS STEEL DURING TURNING	203
28	CHAPTER 28: COMPARISON OF MACHINABILITY OF CERAMIC INSERT IN ROOM TEMPERATURE AND CRYOGENIC COOLING CONDITIONS DURING END MILLING INCONEL 718	209
29	CHAPTER 29: HIGH SPEED END MILLING OF SINGLE CRYSTAL SILICON SING DIAMOND COATED TOOL	217
30	CHAPTER 30: IMPLEMENTATION OF HIGH SPEED OF SILICON USING DIAMOND COATED TOOLS WITH AIR BLOWING	225
31	CHAPTER 31: ELIMINATION OF BURR FORMATION DURING END MILLING OF POLYMETHYL METHACRYLATE (PMMA) THROUGH HIGH SPEED MACHINING	233
32	CHAPTER 32: WEAR MECHANISMS IN END MILLING OF INCONEL 718	239

33	CHAPTER 33: PERFORMANCE OF UNCOATED WC-CO INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSiC)	247
34	CHAPTER 34: APPLICATION OF PCD INSERTS IN END MILLING OF ALUMINUM SILICON CARBIDE (ALSIC)	253
35	CHAPTER 35: EFFECTS OF SCRIBING WHEEL DIMENSIONS ON LCD GLASS CUTTING	259

Chapter 3

Some Aspects of Improved Machinability in Preheated Machining of Titanium Alloy Ti-6Al- 4V

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1.0 INTRODUCTION

Titanium and its alloys have found wide application in the aerospace, biomedical and automotive industries owing to their good strength-to-weight ratio and high corrosion resistance. However, these alloys have very poor machinability, which is attributed to their inherent high strength maintained at elevated temperature and low thermal conductivity. High chemical reactivity of titanium at high elevated temperatures, especially with titanium based tools or coatings limit their application during machining. The strategy of titanium machining is to use tools which show less reactivity, has higher thermal conductivity to increase the chip-tool contact length and effectively take away the generated heat and to use tougher and harder tools which could withstand the dynamic action of the cutting force. The recommended tools for many years had been the uncoated tungsten carbide grade K. However, modern trend is to use Poly Crystalline Diamond (PCD) tools for machining of this particular alloy. In this work the effectiveness of PCD has been compared to that of uncoated tungsten carbide tool in machining titanium alloy Ti-6Al-4V. The comparison has been made in terms of the applicable cutting speed ranges, tool wear rates, tool wear morphology, chip segmentation and chip-tool contact lengths.

Titanium and its alloys have been experiencing extensive development over the past few decades stimulated by a series of their unique properties, such as, high strength to weight ratio maintained at elevated temperatures, high fracture resistance and exceptional resistance to corrosion at temperatures below 500 °C. Though the initial applications of Titanium alloys have been in the aerospace industries in aero-engine and airframe manufacture, there is a growing trend in their application in the industrial sector, which includes petroleum refining, chemical and food processing, surgical implantation, nuclear waste storage, automotive and marine applications. Despite the increased usage and production of titanium and its alloys, these materials fall under the category of the most difficult to machine materials which is attributed to